



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/965,587	09/27/2001	Roch Georges Archambault	CA9-2000-0030	3494
7590 07/12/2004			EXAMINER	
Ronald L. Drumheller, Esq. 94 Teakettle Spout Road Mahopac, NY 10541			VO, TED T	
			ART UNIT	PAPER NUMBER
			2122	

DATE MAILED: 07/12/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

09/965,587

Applicant(s)

ARCHAMBAULT, ROCH  
GEORGES

Examiner

Ted T. Vo

Art Unit

2122

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 27 September 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-25 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 10-12, 22-24 is/are allowed.
- 6) ☒ Claim(s) 1-5, 9, 13-17, 21 and 25 is/are rejected.
- 7) ☒ Claim(s) 6-8 and 18-20 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

**DETAILED ACTION**

1. This action is in response to the application filed on 09/27/2001.

Claims 1-25 are pending in the application.

***Claim objections***

2. Claim 25 is objected to because its dependent/independent form is unclear. Claim 25 recites as an independent scope, but appears to be connected with another independent claim (improper dependent). The claim is required to be amended to place it in proper dependent form, or may be redrafted as an independent claim.

***Claim Rejections - 35 USC § 102***

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1, 13, and 25 are rejected under 35 U.S.C. 102(b) as being anticipated by Aho et al., "Compilers Principles, Techniques, and Tools", 1988.

Examiner note: Due to high volume of the reference, some sections relating to citations are mailed. The whole reference of Aho would be referred to herein by Examiner.

Given the broadest reasonable interpretation of followed claims in light of the specification.

Art Unit: 2122

As per Claim 1:

Aho discloses,

*An optimizing compiler for compiling computer code, the optimizing compiler comprising,*

*means for identifying a store operation at an original location in the computer code as a candidate for forward movement (See page 640, Fig. 10.36 (a) and (b), "I:=2", a candidate; see page 633: Algorithm 10.7: "transformation", "out of loops": for "forward" movement: "Out of loops" has means either forward or backward movement),*

*means for identifying a location in the code into which the candidate store operation may be moved, at which identified location the store operation will not always be executed (See page 640, Fig. 10.36 (a) and (b), For example: stored value in I before entering block B2 and after exiting block B4 is a 2), and*

*means for comparing the nearest preceding definition point for the variables in the store operation at both the original location and at the identified location to determine whether the candidate store operation may be correctly moved forward (See Page 629, optimized equations (10.10), and see page 631, Live-Variable Analysis: Applied these concepts to Algorithm 10.8 (page 641) would determine a safe movement of a variable. Regarding Fig. 10.36: relatively, instruction (a) I:=2 could be said as moving forward along the loop path, or moving backward via the branch of block B2, to block B6 in Fig. 10.36)*

*to the identified location and to specify the type of movement available in the potential optimization (See Fig. 10.36 in regard to positions of "I:=2").*

As per Claims 13 and 25: Claims 13 and 35 recite the method and program product that have the functionality corresponding to the optimizing compiler claimed in Claim 1. Therefore, Claims 13 and Claim 25 are rejected in the same reason set forth in connecting to the rejection of Claim 1.

***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

A person shall be entitled to a patent unless –

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 2-5, 9, 14-17, 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Aho et al., "Compilers Principles, Techniques, and Tools", in view of Muchnick, "Advance Compiler Design Implementation" 1999.

Examiner note: Due to high volume of the reference, some sections relating to citations are mailed. The whole reference of Muchnick would be referred to herein by Examiner.

Given the broadest reasonable interpretation of followed claims in light of the specification:

As per Claim 2:

Aho discloses, *An optimizing compiler utilizing an intermediate representation of computer code to be compiled, the intermediate representation comprising blocks of computer code and a control flow graph, the optimizing compiler comprising*

*traversing means for traversing the control flow graph* (See page 639, Example 10.30: The statement: Consider the flow graph shown in Fig. 10.36(a). B2, B3, B4 form a loop with header B2, where the flow formation of sequence B2, B3, B4 has means of traversing)

*in breadth-first order commencing at an exit block for the computer code,*

*identifying means for identifying a target block into which a store operation reached in the traversal of the control flow graph may be moved* (See Fig. 10.36 (a) and (b), block that consists the expression  $i:=2$ , where  $i:=2$  is identified as a store operation may be moved),

*selecting means for determining whether the movement of the reached store operation to the target block may be correctly carried out and where the movement may be correctly carried out, adding an entry for the reached store operation and the target block to a store motion list* (See Fig. 10.36(a) and (b) that has means as recited.  $i:=2$  in B6: *an entry for the reached store operation and the target block to a store motion list*), and

*moving means for defining the movement of store operations on the store motion list to the respective locations of the target blocks on the store motion list* (See Fig. 10.36(a) or (b) that has moving means  $i:=2$  in B3 moved to B6: Variable  $i$  has means of *store motion list*).

Aho does not address traversing the control flow graph in such manners: *in breadth-first order commencing at an exit block for the computer code*: as recited in *traversing means*.

Muchnick discloses *in breadth-first order commencing at an exit block for the computer code* (Muchnick: pages 177, 181, particularly, page 181, FIG. 7.13) as one of standard techniques/graph-theoretic concepts used in tree search/flow analysis for determining reaching definitions.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to include *in breadth-first order commencing at an exit block*, as discussed by Muchnick with the teaching code motion of Aho. The modification would be obvious because one of ordinary skill in the art would be motivated for utilizing standard techniques which are set forth as common rules used in tree searching for analyzing live variables.

As per Claim 3: Aho further discloses, "*The optimizing compiler of claim 2 in which the identifying means comprises means for identifying a target block by selecting a side node in the intermediate representation*" (See Fig. 10.36, a side node: block B3).

As per Claim 4: Muchnick further discloses,

*"The optimizing compiler of claim 2 in which the intermediate representation further comprises a data flow graph, a dominator tree, and a post-dominator tree, and in which the identifying means further*

Art Unit: 2122

*comprises means for defining a set of reached uses blocks for the reached store operation, the set of reached uses blocks being defined by accessing the data flow graph, means for traversing the dominator tree and for traversing the post-dominator tree to define the target block to be the first descendant, if any, of the reached store operation block which both*

- 1. dominates each block in the set of reached uses blocks, and*
- 2. does not post-dominate the reached store operation block"*

(Muchnick: See pages 183-191, section 7.3), as a technique used to determine Dominators and Postdominator in building a dominator tree.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to further include the standard techniques in data flow graph, a dominator tree, and a post-dominator tree in rebuilding tree dominator of Muchnick as discussed in pages 183-191, section 7.3 for easing the analysis in determining live variables and reaching definitions.

As per Claim 5: Aho further discloses,

*"The optimizing compiler of claim 2 in which the intermediate representation comprises a reaching defs table, and in which the selecting means comprises means for comparing the reaching defs value for each load in the address expression of the reached store operation at its original location, with the reaching defs value for each load in the address expression of the reached store operation at the target block location, by accessing the reaching defs table, and means for signaling the addition of an entry to the store motion list where the comparison of the said reaching defs values match"* (See Aho: entire sections 10.5, started at page 608, that discusses reaching definitions).

As per Claim 9: Aho further discloses, *"The optimizing compiler of claim 2, in which the intermediate representation of the code includes a tree representation and in which the traversal of the tree representation of code is carried out in a backward traversal order"* (See section 10.12: Estimate of Types, started at page 694; particularly, at page 699: The Backward Scheme).

Art Unit: 2122

As per Claim 14: Claim 14 recites the method that has the functionality corresponding to the optimizing compiler claimed in Claim 2. Therefore, Claim 14 is rejected in the same reason set forth in connecting to the rejection of Claim 2.

As per Claim 15: Claim 15 recites the method that has the functionality corresponding to the optimizing compiler claimed in Claim 3. Therefore, Claim 15 is rejected in the same reason set forth in connecting to the rejection of Claim 3.

As per Claim 16: Claim 16 recites the method that has the functionality corresponding to the optimizing compiler claimed in Claim 4. Therefore, Claim 16 is rejected in the same reason set forth in connecting to the rejection of Claim 4.

As per Claim 17: Claim 17 recites the method that has the functionality corresponding to the optimizing compiler claimed in Claim 5. Therefore, Claim 17 is rejected in the same reason set forth in connecting to the rejection of Claim 5.

As per Claim 21: Claim 21 recites the method that has the functionality corresponding to the optimizing compiler claimed in Claim 9. Therefore, Claim 21 is rejected in the same reason set forth in connecting to the rejection of Claim 9.

#### ***Allowable Subject Matter***

7. Fowling are allowable subject matter to Claims 6-8, 10-12, 18-20, and 22-24.

As per Claims 10-12 and 22-24: Claims 10-12 and 22-24 are allowed.

The following is an examiner's statement of reasons for allowance:

The cited prior arts taken alone or in combination fail to teach an optimizing compiler and a method comprising at least features,

*"means to traverse the store motion list, means to determine the movement type for a store operation corresponding to an entry reached in the traversal of the store motion list, the movement type being determined by comparing the reaching defs values for each use in the right hand side expression of the reached store operation at its original location, with the reaching defs value for each use in the right*



Art Unit: 2122

*hand side expression of the reached store operation at the target block location, by accessing the reaching defs table, and where the full set of values match, setting the movement type of the reached entry to designate a move of the entire store operation, where a subset of the values match, setting the movement type of the reached entry to designate a move of the partial right hand side of the store operation, storing in the store motion list the variables which are not able to be moved to the target block, and where none of the values match, setting the movement type of the reached entry to designate a move of the left hand side of the store operation", as recited in the independent Claim 10, and in the such manners as recited in the independent Claim 22.*

Closest arts of record, Aho and Muchnick, fail to disclose such features as addressed above.

As per Claims 6, 18: Claims 6 and 18 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The limitations of Claims 6 and 18 comprise at least features that are indicated as being allowable as recited in the manners as addressed in Claim 10 above.

As per Claims 7-8, 19-20: Claims 7-8 and 19-20 are objected to as being dependent upon the objected Claims 6 and 18, respectively.

### **Conclusion**

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ted T. Vo whose telephone number is (703) 308-9049. The examiner can normally be reached on Monday-Friday from 8:00 AM to 5:30 PM ET. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tuan Dam, can be reached on (703) 305-4552.

The fax phone numbers:

(703) 872-9306 (for formal communication intended for entry);

(703) 746-5429 (for informal or draft communication, please label "PROPOSED" or "DRAFT").

Application/Control Number: 09/965,587

Page 9

Art Unit: 2122

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 305-3900.

TED T. VO

Patent Examiner  
Art Unit: 2122  
July 2, 2004